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CANMET ANNUAL BIBLIOGRAPHY OF CRUSHING AND GRINDING - 1985

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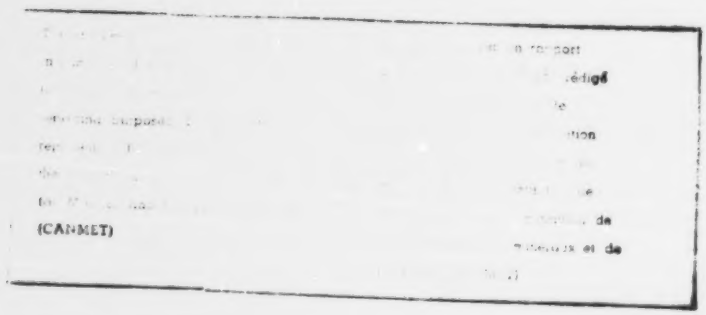

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CANMET ANNUAL BIBLIOGRAPHY OF CRUSHING AND GRINDING 1985

BY

D.C. LUMB

ABSTRACT

This report is a comprehensive bibliography of the latest machinery, techniques and crushing-grinding circuits for the year 1985.

Keywords: Crushing, Grinding, Crushing Mill, Grinding Mill, Grinding Circuit, Process Control, Automation.

RÉPERTOIRE BIBLIOGRAPHIQUE DES TECHNIQUES DE CONCASSAGE ET DE BROYAGE UTILISÉS EN 1985 - TRAVAIL RÉALIS PAR CANMET

PAR

D.C. LUMB

RÉSUMÉ

Ce rapport constitue une bibliographie exhaustive de la machinerie, des techniques et circuits de concassage et de broyage les plus récents utilisés en 1985.

Mots clé: Concassage, broyage, appareils de broyage, broyeurs, circuits de broyage, contrôle des opérations, automatisation.

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CANMET ANNUAL BIBLIOGRAPHY OF CRUSHING 1983

INTRODUCTION

This report presents bibliographical information on the subject of crushing and grinding. Articles were categorized and numbered sequentially according to the yearly quarter in which they were cited. Although some ambiguity may exist in the article allocations, the categories were chosen to facilitate specific subject searches while retaining the convenience of a general breakdown.

REFERENCING SYSTEM

The references in this report were obtained through the CAN/SDI system covering the 1985 issues of the following data bases:

CHEMICAL ABSTRACTS
COMTENDEX
METADEX (Metals Abstracts)
NTIS (National Technical Information Service of the U.S. Dept. of Commerce)
SCIENCE CITATION INDEX

The references were numbered according to the months in which the data bases cited the reference. A photocopy of each article was made and may be found filed according to its reference number at the CANMET Mineral Ore Dressing Laboratories, 552 Booth St. Also at the same location is an author-index listing various authors and their articles for which photocopies have been made.

The references appearing in this report were numbered in the following method:

January, February, March 1985	2500 - 2534
April, May, June, 1985	2600 - 2631
July, August, September, 1985	2700 - 2743
October, November, December 1985	2800 - 2850

ACKNOWLEDGEMENT

I would like to thank the support and cooperation of W.H. Cameron, J. MacCauley, Canada Centre for Mineral and Energy Technology, and Energy, Mines and Resources Canada.

1985 (A) REVIEW AND GENERAL ARTICLES

2503 Morrice, E., Walkiewicz, J.W., Casale, G. (Dept. Interior, USA (US)), "Pilot Mill Flotation of Serpentized Platinum-Palladium Ore From the Stillwater Complex"; Rep. Invest. - U.S. Bur. Mines, No. RI 8885, 1984, p.11; ISSN 0096-1922; XBMIA

CA154001; Platinum Palladium Ore Flotation

Palladium Ores, Platinum Ores, 25306-75-6; 112-55-0

2506 Parekh, B.K., Epstein, H.E., Goldberger, W.M. (Iron Works Pike, Inst. Min. Miner. Res., Lexington, KY, USA (US)), "Novel Comminution Process Uses Electric and Ultrasonic Energy"; Min. Eng. (Littleton, Colo.), Vol. 36, No. 9, 1984, pp. 1305-1309; ISSN 0026-5187; MIENA

CA154001; Molybdenite Comminution Elec. Ultrasonic Energy, Pyrite Liberation Molybdenite Ultrasonic Energy, Quartz Liberation Molybdenite Ultrasonic Energy, Copper Ore Electroacoustic Comminution, Iron Ore Electroacoustic Comminution

Copper Ores, Iron Ores, Electric Discharge, Sound and Ultrasound, Ore Treatment, 1390-65-4; 14808-60-7; 1309-36-0

2508 Lucas, G.C., Nelson, I.F., Walker, P.J., "Mining and Ore Processing at Queensland Mines Ltd.'s Nabarlek Uranium Treatment Plant"; Darwin Conference, Darwin, Australia, Aug. 1984; Australasian Institute of Mining and Metallurgy, 191 Royal Parade, Parkville, Victoria, Australia 3052 (1984), 167-174; See: 85-01-72-0008

42, Uranium, Extraction, Solvent Extraction, Leaching, Grinding (Comminution), Stockpiling

Ore is fed to the mill by a front-end loader, grinding is carried out by a semiautogenous grinding (SAG) mill followed by a ball mill in closed circuit with a spiral classifier. The slurry is thickened before being fed to a conventional acid leaching circuit, using Caro's acid as oxidant. Solid-liquid separation takes place in a countercurrent decantation (CCD) circuit with the liquor being purified and concentrated by amine solvent extraction. Ammonia precipitation is utilized and the precipitate is washed prior to calcination at 650°C. The product is packaged in 200 L drums and stored

ready for containerized shipment. Metallurgical recovery averages 97.5% while attaining product grade of 98.5% U.

2509 Eltham, J.A., "Mining and Processing of a Low-Grade Gold Orebody in the Wau Valley, Papua, New Guinea"; Darwin Conference, Darwin, Australia, Aug. 1984, Australasian Institute of Mining and Metallurgy, 191 Royal Parade, Parkville, Victoria, Australia 3052 (1984), 427, 434; See: 85-01-7-20008

42, Gold, Extraction, Grinding (Comminution), Gravity Concentrators, Solvent Extraction, Amalgamation

Renison Goldfields Consolidated Ltd. (RGC) and Consolidated Gold Fields Plc (CGF) purchased New Guinea Goldfields Ltd. (NGG) in 1982 as an exploration venture. Following an intensive drilling program in the upper ridges sufficient ore reserves were outlined to justify the installation of a new 700 tons of ore/day gravity Au extraction plant. Major considerations in the design of the new plant were to minimize production interruptions in the existing plant and to include simple, but technically efficient, equipment that could be operated and maintained by a workforce with limited experience in modern technology. These goals were achieved over a six month period, commissioning being carried out in Apr. 1983. Mining the epithermal Au deposit is by open cut benching and truck haulage. The gravity concentrator includes a scrubber, wet hammer mill and rod mill, to crush, grind and prepare the ore for sizing and desliming. Gold recovery units consist of a jig, spirals, shaking tables and amalgam barrels. Although most of the Au is in the -100 +20 μm M size fraction, a recovery of 63%, from a head grade of 2.0 g/ton, is achieved.

2510 Khoe, G.K., Ruda, M.M., Epstein, N. (Univ. of British Columbia, Dept. of Chemical Engineering, Vancouver, B.C., Can.), "Batch Comminution of Coal in a Spouted Bed"; Powder Technology, Vol. 39, No. 2, Sept. 1984, pp. 249-262; 15 Refs; ISSN 0032-5910; POTEB

1 - Coal Preparation - Breakage; Grinding Mills; Coal Pulverizers; Supported Bed A524; A802

Batches of coal were subjected to comminution in a spounted bed using glass beads as the grinding medium. The basic coal comminution mechanisms of attrition, impaction and crushing were also individually studied,each in a different kind of apparatus, and the first two mechanisms were also each successively accentuated in the spouted bed by use of appropriate inserts. The particle size distribution of the

coal was determined at frequent intervals for each run. An attempt was made to interpret and model the spouted bed results mechanistically.

2513 Revnivtsev, V.I., Kostin, I.M., Yashin, V.P., "Main Trends in the Development of Ore Preparation for Beneficiation"; Tsvetn. Met., May 1984, (5) 96-100; ISSN 0041-4891

41 - Beneficiation; Fragmentation; Crushing; Breaking

Reduction in the content of valuable components in ores and more stringent requirements as to the completeness of extraction and the complexity of utilization of raw material have given rise to the need for improvement in ore preparation. The main principles of efficient organization of the breaking up of mineral aggregations have been established by the Mekhanobr Institute: application of repeated loads to the material and the use of different methods of ore softening. An analysis is made of the current state of ore preparation and main trends in its development.

2516 Grekulova, L.A., Litvintsev, E.G., Voevodin, Yu A., Yur'ev, V.I. (USSR (SU)), "Combined Technology for Concentration of Tin Ores"; Tsvetn. Met. (Moscow), No. 10, 1984, pp. 95-99; ISSN 0372-2929; TVMTA

CA154001; Tin Tungsten Ore Beneficiation, Gamma Ray Radiometry Ore Sepn.

Gamma Ray, Tin Ores, Tungsten Ores, 14596-10-2

2524 Rowland, C.A., Jr., "Testing for the Selection of Comminution Circuits to Prepare Concentration Feed"; AIMM Bull., March 1984, pp. 79-91; ISSN 0158-6602

41, Ores, Beneficiation. Comminution; Economics, Impact Tests; Grindability; Crushing

The selection of the best comminution circuit for the preparation of concentration feed is a compromise based on economics, energy efficiency, labour costs, steel consumption, availability and other factors specific to each case. It is postulated that the selection must be a choice of one of the eight basic comminution circuits which can be divided into two basic groups, (1) Autogeneous or semi-autogeneous primary mills with or without a secondary grinding stage and (2) fine crushing usually in cone crushers followed by a rod mill-ball mill circuit or a single stage ball mill circuit. The accuracy of selection may be improved

by pilot plant and laboratory tests which are described in this paper. For (1) above, testing includes media competency tests with standard impact crushing, grindability and abrasion tests followed by pilot plant tests. For (2), above, bench scale crushability, grindability and abrasion testing is available. It is suggested that, through these tests, it should be possible to eliminate all but one in each group of basic comminution circuits, then engineering and economic studies should lead to the best comminution circuit for the specific requirements. 8 Ref.

2527 Kalinowski, Krysian (Silesia Technical Univ., Gliwice, Pol.), "Manufacturing Optimization of the Technological Unit for Crushing the Dressing Coal Products"; Stud. Geotech. Mech., Vol. 6, No. 1, 1984, pp. 33-37; 3 Refs.; ISSN 0137-6365; SGMED

A425; A921; 1 - Coal Preparation - Optimization; Mathematical Models; Coal Dressing

Treat: T (Theoretical)

This paper deals with the problem of choosing the optimal set up of the machines constituting a technological unit of a coal dressing plant - crushing and secondary dressing of by-products. The unit consists of a crusher with a controllable spline and a jig capable of selecting the separation density. For eight different coal beds of a chosen mine an optimal spline gap of the crushing mill and the separation density of the jig are established bearing in mind the maximum flow-off of the concentrate including the assumed ash content. It is found that the optimal set-up of the machines depends on the kind of feed supplied to the technological unit.

2612 Berube, M.A. (Univ. Laval, Quebec, Que. Can.), "Influence of Mineralogical Composition on Grinding and Flotation at the No. 1 Concentrator at Gaspé Mines (Murdochville, Quebec) / Influence de la composition minéralogique du minérai sur les performances des procedés de broyage et de flottation au concentrateur N "Degree" 1 de Mines Gaspé (Murdochville, Québec); Cim. Bull., Vol. 77, No. 872, Dec. 1984, pp. 54-62; 8 Refs; ISSN 0317-0926; CIBUB;

A533; 1 - Copper Ore Treatment - Crushing and Grinding
Treat: X (Experimental)

The capacity of the grinding circuit seems mainly influenced by variations in the mineralogical and textural properties of the ore. An increasing ratio of garnet/quartz leads to decreasing grindability. The proportion of copper minerals difficult to recover by flotation, such as copper carbonates, varies within the deposit. The degree of liberation of copper sulfides is chiefly a function of size distribution. In French with English abstract.

2628 Austin, L.G., Rogers, R.S.C. (Penn. State Univ., Dept. Mineral Engn., University Pk, PA 16802; Kennedy Van Saun Corp. Danville, PA 17821), "Powder Technology in Industrial Size-Reduction"; Powder Technology, Vol. 42, No. 1, 1985, pp. 91-109; Ref: 088

2631 Anon. (Soc. of Mining Engineers of AIME, Littleton, CO, USA), "In Pit Crushing and Grinding II (Held at the Society of Mining Engineers of AIME, 1983 Fall Meeting)"; Mini Symp. Soc. Min. Eng. AIME, No. 83-MPD-M&E-06, In Pit Crushing and Grinding II, Salt Lake City, UT, USA, Oct. 19-21, 1983. Publ. by Soc. of Mining Engineers of AIME, Littleton, CO, USA, 1983, 56 p.; MSSAD;

A533; A502; 1 - Crushing and Grinding; Mines and Mining - Open Pit; Crushers - Design; In-Pit Movable Crushers; Gyratory Crushers; Apron Feeders; Crawler Transporters; EIREV

Treat: G (General Review)

This conference proceedings contains 5 papers. The papers discuss: arpon feeders; primary crushers; in-pit belt feeders; indirect crusher feeding; in-pit movable primary crushing equipment; boom/impactor selection; mobile gyratory crusher; economic incentives; crawler/transporter use; and portable rock handling equipment. Technical and professional papers from this conference are indexed with the conference code No. 04210 in the EI Engineering Meetings (TM) Database produced by Engineering Information, Inc.

2701 Moiseev, V.P., Zborschik, A.M., Dorokhov, V.V., Kiseleva, I.V., Vlasov, P.E. (USSR (SU)), "Increasing the Strength of Crushing Equipment for Processing Oxidized Nickel Ores"; Tsv. Metallurgiya, No. 11, 1984, pp. 73-765, D3RAP; From Ref. ZH., Metall., 1985, Abstr. No. 3680

CA154004; Nickel Ore Oxidn Crushing Wear, Weld Surfacing Electroslag Crushing Ore

Welding, Nickel Ores, Ore Treatment

2722 Flavel, M.D., Rowland, C.A. Jr. (Allis-Chalmers Solids Process Equipment Systems Co., Milwaukee, WI, USA), "Selecting Circuits to Prepare Beneficiation Circuit Feed From Primary Crusher Product"; Miner. Metall Process, Vol. 1, No. 3, Nov. 1984, pp. 209-219; 8 Refs; ISSN 0020-0891; MMPRE;

A533; A802; A423; 1 - Ore Treatment - Beneficiation; Crushing and Grinding - Testing; Crushers - Selection; Grinding Mills - Selection; Semi-Autogenous Mills; Cone Crushers; Rod Milling; Ball Mills; Secondary Autogenous Mills

Treat: X (Experimental)

There are seven basic communication circuits that can be used to prepare beneficiation feed from the product of a primary crusher. This paper gives a comparison of these circuits based on average process and economical data. The paper is principally devoted to a discussion of the test work required to obtain the process data needed to evaluate each circuit. The results of the test work in conjunction with geographic and economic factors.

2724 Dunne, Robert Charles; Liddel, Shelagh Jane (S. Afr. (XA)), "Improved Recoveries of Gold from Auriferous Calcines and Pyrites by Fine Milling"; Rep.-Mintek, No. M161, 1984, p. 10; ISSN 0254-1815; RMNTD

CA154002; Gold Leaching Ore Milling; Calcine Ore Milling Gold Leaching; Pyrite Ore Milling Gold Leaching

Gold Ores; 7440-57-5

2725 Ruhmer, Walter Theodore, (Counc. Miner. Technol., Randburg, S. Afr. (ZA)), "A Techno-Economic Evaluation of Five Routes for the Comminution of Gold Ores in South Africa"; Rep. - Mintek, No. (M182), 1985, p. 57; ISSN 0265-1815; RMNTD

CA154001; Gold Ore Crushing Milling; Comminution Gold Ore Economics

Ore Treatment; Ore Treatment; Gold Ores

2739 Miller, K.J. (Department of Energy, Pittsburgh, PA, Pittsburgh Energy Technology Center), "Investigation of Fine Grinding and Flotation to Produce Superclean Coal"; DE85014337/XAD, May 85, 6 p. (DOE/NBM-5014337)
21D; 97K; 48A; *Coal Fines; Coal; Ash Content; Bench-Scale Experiments; Comparative Evaluations; Experimental Data; Flotation; Grinding; Particle Size; ERDA/01300; ERDA/01600; NTISDE

Laboratory flotation tests were conducted with dry-ground and wet-ground coal to determine the effect of grinding methods on clean coal recovery and product grade. A laboratory jar mill, a stirred ball mill, and an air-classifying vertical impact mill were used for grinding the coal samples. Products of as near the same size distribution as possible were prepared by each method (i.e. nominal minus 27 μm with a mean particle size of 10 to 12 μm). The test results show that dry-ground coal is more floatable at lower reagent addition levels, but wet-ground coal provides lower ash products. For example, a dry-ground coal yielded about 40 wt % to over 70 wt% of froth product with frother reagent dosages of 0.2 to 0.5 pound per ton of dry solids (lb/ton), and the respective product ash contents ranged from about 2.0% to 3.0%. A wet-ground coal, on the other hand, yielded about 40 wt % to over 70 wt % of froth product with frother reagent dosages of 0.2 to 0.5 pound per ton of dry solids (lb/ton), and the respective product ash contents ranged from about 2.0% to 3.0%. A wet-ground coal, on the other hand, yielded under 30 wt % to a little over 70 wt % froth product with the same frother reagent dosages, but the ash contents ranged from about 1.0% to 1.6%. 5 Refs., 5 Figs., 2 Tabs. (Era Citation 10: 036035)

2803 Muehlen, F., "Optimization of Grinding/Drying Plants / Optimierung von Mahltrocknungsanlagen."; Zem Kalk Gips, Ed. B, Vol. 38, No. 1, Jan. 1985, pp. 31-36; ISSN 0722-4400; ZKGBD;

A802; A414; A482; 1 - Crushing and Grinding - Equipment; Limestone - Crushing and Grinding; Lime - Manufacture; Limestone Processing; Pulverized Limestone; Comminution

Problems associated with the drying of limestone products and the solution thereof are discussed. To achieve optimum operation of a grinding/drying plant, it is essential to have adequate measuring technology. More particularly, the dew-point after the filter, the temperature after the mill and the temperature after the filter must be ascertained. Thermal energy can be saved by attaining minimum exhaust gas temperature, minimum exhaust gas flow rate, maximum air circulation and air recycling rates, good insulation of equipment, advanced comminution of the limestone and 'fractional drying'. In German.

2804 Zisselmar, R., "Tandem Grinding Plant - Features and Operating Results of an Air-Swept Grinding/Drying System for the Economical Preparation of Cement Raw Materials / Die Tandem-Mahlanlage - Aufbau und Betriebsergebnisse eines Luffstrom-Mahltrocknungssystems fuer die Wirtschaftliche Aufbereitung von Zementrohstoffen"; Zem Kalk Gips, Ed. B,

Vol. 38, No. 4, Apr. 1985, pp. 196-200; 8 Refs: ISSN 0722-4400; ZKGBD;

A412; A802; 1 - Cement Plants - Crushing and Grinding; Cement - Raw Materials: Air Separators; Storage Bins; Feedstock Supply; Tube Mill; Cyclone Separator

Treat: A (Applications); G (General Review)

The choice of a suitable cement raw material grinding system remains a difficult one. Conventional systems which have already long been used for the purpose are the air-swept mill, the mill operating in closed circuit with a bucket elevator and the roller mill. Operating results and experience gained with upwards of 50 tandem grinding plants are reported, with particular reference to power consumption, drying performance, wear, maintenance, capital expenditure, monitoring and control. In German.

2805 Kim, Song-Ho, "Operating Results of Cement Grinding Mills with Classifying Liners and Cyclone Separators"; Zem Kalk Gips, Ed. B., Vol. 38, No. 4, Apr. 1985, pp. 203-205; 1 Ref; ISSN 0722-4400; ZKGBD;

A412; A802; 1 - Cement Plants - Crushing and Grinding; Crushers - Classification; Separators - Pneumatic; Classifiers - Performance; Ball Mill; Size Reduction; Cement Grinding; Cooling Air

Treat: G (General Review)

Attempts to modify ball mills for better performance of cement grinding operations are outlined. To improve the performance of air-swept ball mills for cement grinding, the ordinary liners and sturtevant type separators were replaced by classifying liners and cyclone separators. After these modifications, the cement production rate was increased by 15P and the power consumption was decreased by about 13P.

2813 Knight, P.C., Bridgwater, J. (Univ. Birmingham, Dept. Chem. Engn., Birmingham, B15 2TT, W. Midlands, England; Unilever Res., Port Sunlight Lab, Wirral, L63 3J2, Merseyside, England); Powder Technology, Vol. 44, No. 1, 1985, pp. 99-102; Ref: 004

2816 Turetskii, YA.M., Dovgan', E.I., Zheltyakova, I.V., Myl'nikov, V.I., Vdovenko, V.A., "Development of an Efficient Schedule for the Comminution of Sponge Iron Produced by the Reduction Annealing of a Powdered Raw Material. (Translation)"; Sov. Powder Metall. Met. Ceram. (Oct. 1984), Vol. 23, No. 10, pp. 756-759; ISSN 0038-5735

54; Sponge Iron, Powder Technology; Grinding (Comminution); Particle Size Distribution; Crushers

See Preceding Abstract.

2825 Fernie, A.D. (Wright Engineers Ltd., Vancouver, B.C., Can.), "Pit to Plant - Current Trends"; Min. Eng. (Littleton, CO), Vol. 37, No. 1, Jan. 1985, pp. 49-54; 1 Ref; ISSN 0026-5187; MIENA

A502; A691; A531; A911; 1 - Mines and Mining - Conveying; Ore Handing; Ore Treatment - Crushing and Grinding; Cost Accounting - Costs; Materials Handling; Pit Crushing; High Wall; Cone Pit; Conveying System

Treat: A (Applications); E (Economic/Cost Data/Market Survey)

Growing interest in pit crushing and conveying is evident from the recent many articles, technical papers, and new equipment development. Application of a pit crushing and conveying system is complex. Many factors, such as mine design, production scheduling, as well as initial and ongoing capital and operating costs must be thoroughly and realistically examined. This paper addresses the fundamentals to be considered and reviews several approaches to developing a total system for a new and existing mine situation. The planning function was outlined and operating and design criteria defined to interface the mining operating and the pit crushing conveying system.

2835 Belova, T.V., Scherbakov, V.I., Sinichkin, A.G., Gramatunov, P.M., "An Improved Flow Chart of Ore Preparation at a Gold-Extraction Plant"; Tsvetn. Met. (1985), (5) pp. 92-94; ISSN 0041-4891

42; Gold, Extraction, Ball Milling; Flotation
An improved flow chart for the preparation and gravity concentration of Au ores is proposed which makes it possible to increase the productivity of the first-stage mill, increase the yield of free Au, and improve the overall performance of the crushing and classification equipment. In accordance with the process proposed here, the minus product of the first-stage mill (mms 70 x 23 cm) is fed directly to the jigging machines for concentration bypassing hydrocyclones, while the discharge of the first-stage classifier is subjected to control classification in hydrocyclones and the sand is directed to the second stage of classification.

2836B Melnikov, V.A., Peskov, V.V., Denisov, V.Kh., Ivanov, V.I., "Preparing Concrete-Contaminated Copper - Nickel Ores for

Concentration"; Tsvetn. Met. (1985), (5), pp. 94-96; ISSN 0041-4891

41; Copper Ores; Beneficiation; Nickel Ores; Beneficiation; Grinding (Comminution); Flotation; Magnetic Separation; Cements, Impurities

An improved process for the preliminary gravity concentration of Cu-Ni ores is proposed with a view to increasing the efficiency and cutting the costs of ore preparation. For large (+8 mm) ores, the process includes a two-stage treatment in heavy suspensions (2.5 and 3.1 t/m exp. 3, consecutively) and results in the separation of concrete, wood, low-density gangue, and ingrained ore. For fines (—8mm), concentration in hydrocyclones is employed. 7 Refs.

1985 (B) CRUSHING

2606 Bauer, E.E. (Consolidated Technol. Corp., Div. Min., Denver, CO 00000), "Selection of Boom and Impactor for Mobile Gyratory Crusher"; Mining Engineering, Vol. 37, No. 2, 1985, pp. 153-158; Ref:003

2620 Rogers, B.S. "Crushers - What the Market Has to Offer"; Canadian Mining Journal, Vol. 106, No. 3, 1985, p. 27; Ref: 000

2626 Mueller-Roden, H. (Technische Univ. Berlin, Inst. fuer Bergbauwissenschaften, Berlin, West Ger.), "In-Pit Crushing and Trolley-Assisted Truck Haulage in Hard Rock Open-Pit Mines"; Bulk Solid Handl., Vol. 4, No. 4, Dec. 1984, pp. 775-778; ISSN 0173-9980; BSHAD;

A502; A691; 1 - Mines and Mining - Open Pit; Industrial Trucks - Applications; Materials Handling - Performance; Haulage; Crushing; Feasibility Study; Truck Speed Treat: A (Applications); E (Economic/Cost Data/Market Survey)

The international conference on the "Planning and Operating of Open Pit and Strip Mines", organized by the University of Pretoria, the South African Institute of Mining and Metallurgy, and the University's Mining Alumni Society, was held at the University of Pretoria Campus from April 9 to 13, 1984. The conference consisted of four parts, of which one dealt with new developments in open-pit mining, such as in-pit crushing, trolley-assisted truck haulage, and computer applications. This article presents a critical discussion on the experience gained from that conference and a visit to several mines in the Republic of South Africa.

2703 Koerberer, G. (Claudius Peters, D-2000, Hamburg 60, Fed. Rep. Ger.), "Operating Experience with a New Type of Clinker Crusher"; Zement Kalk Gips, Vol. 38, No. 5, 196, pp. 262-263; Ref: 001

2704 Robertson, J.L., "Vertical Shaft Crusher Saves Fuel"; Rock Products, Vol. 88, No. 6, 1985, pp. 32-35; Ref: 000

2705 Robertson, J.L., "Increased Breakage by Blasting Results in Lower Crushing Costs"; Rock Products, Vol. 88, No. 6, 1985, p. 24; Ref: 000

2727 Kuga, Y., Koga, J., Yamaguchi, K., Indue, I. (Inst. Phys. & Chem. Res., Powder Technol. Lab, Wako Saitama 315 Japan), "An Investigation of the Comminution Process of a Screen Mill Based on Data of Impact Crushing"; Journal of Chemical Engineering of Japan, Vol. 18, No. 3, 1985, pp. 270-273; Ref: 008

2728 Chironis, N.P., "In-Pit Conveyors and Crushers Cut Surface Mining Costs"; Coal Age, Vol. 90, No. 7, 1985, pp. 61-65; Ref: 000

2731 Frizzel, E.M. (US Bur. of Mines, Spokane Research Cent., Spokane, WA, USA), "Mobile In-Pit Crushing -Product of Evolutionary Change"; Min. Eng. (Littleton, CO), Vol. 37, No. 6, June 1985, pp. 578-580; 21 Refs: iSSN 0026-5187; MIENA

A533; A414; A482; 1 - Crushers; Limestone - Crushing and Grinding

Treat: G (General Review)

Mobile in-pit crushing and conveying have increased to more than 74 installations. The capacity, type of crusher, and material being processed appear in a table. Experience to date has been influenced by limestone installations of less than 1 kt/h (1102 STPH).

2800 Krol, I.M, Molitivin, B.N. (USSR (SU)), "Crushing of Iron-Containing Ores in Conical Crushers KSD-3000T and KMD-30005"; Obagashch, Rud. (Leningrad), No. 1, 1985, p. 27-30; ISSN 0029-7623; OBOGA

CA154001; Iron Ore Crushing App. Productivity; Particle Size Iron Ore Crusher

Particle Size; Iron Ores

2808 Theiner, J., "Large Mobile Crushing Plant for 3900 T/Hour in a Limestone Quarry in Somerset, England"; Zement-Kalk-Gips, Vol. 38, No. 8, 1985, pp. 437-440; Ref: 000

2812 Anon. "Mobile Crusher, Conveyor Concept Introduced in British Quarry"; Mining Engineering, Vol. 37, No. 6, 1985, p. 594; Ref: 000

1985 (C) GRINDING

(C) Grinding (i) Ball and Rod Milling

2522 Ebner, Josef, Gambin, Yves (Ste Wagner-Biro, Dep. Concassage-Broyage, Vienna, Austria), "Reduction of the Operating Costs for Small Mills by Utilizing Angular Spiral Armors (ASA) / Reduction des couts d'exploitation des broyeurs a boulets grace a l'utilisation de blindages de type angulaire spiral (BAS)"; Ind. Miner, Vol. 66, No. 5, May 1984, pp. 239-244; 14 Refs.: INMNC

A533; A802; A911; 1 - Grinding Mills - Ball Milling; Crushing and Grinding - Costs

Treat: A (Applications); E (Economic/Cost Data/Market Survey)

Waagner-Biro, an Austrian company, has developed after several industrial and pilot tests, an original system of armour plating for ball mills which could cut down by 10 to 25% in the specific power consumption. Besides, this system brings a reduction of the sound level of the crusher and a longer life of the controls. With this kind of armour plating, the section of the core of the crusher traditionally circular, turns into a square section with rounded angles. Moreover, each row of armour plating is displaced by a few degrees compared with the previous one producing a kind of spiral on the whole length of the crusher. At present, sixty ball-mills of different sizes and treating different products are equipped with the system. This resulted in a significant reduction of operating costs. In French with English abstract.

2528 Marchal, Gerard (Fives-Cail Babcock, Grinding Systems Dep.), "Re-establishment of the Lateral Drive for Driving the Large Ball-Mills / Rehabilitation de l'attaque laterale pour l'entrainement des broyeurs a boulets de grandes dimensions"; Cim Beton Platres Chaux, No. 2/84 - 747, 1984, pp. 78-89; ISSN 0397-006X; CBPCD

A533; A601; A602; 1 - Grinding Mills - Ball Milling; Gears - Speed Control; Mechanical Drive - Equipment; Rotating Speed; Starting System; Excess Torque

Ball-mills are cylindrical machines which rotate at a speed characterized by its percentage as against the critical speed. The critical speed is the one under which all balls on the periphery of the rotating mill would be "struck" by the centrifugal force against the mill periphery. The formula indicating the critical speed is: 42.3/D. D is expressed in meters and corresponds, according to the various authors, to the internal diameter of the shell or of the lining. According to this formula, the larger the mills, the slower they will rotate. Of course, this will set the problem of stress as regarding the teeth of the driving gear. In French and English.

2533 Nadeau, F., Bussiere, J.F., "Acoustic Sorting of Grinder Balls"; Mater. Eval., Nov. 1984, Vol. 42, No. 12, pp. 1515-1519; ISBN: ISSN 0025-5237

22, Carbon Steels, Non-destructive Testing, Ball Mills, Acoustic Emission, Cracking (Fracturing)

An automated non-destructive testing device using acoustic flaw detection for ball-mill grinder balls (high-carbon steel) was developed. An initial study of the sound generated in air by the impact of grinder balls has shown that the changes in ball velocity upon impact produce an initial low-frequency pressure pulse and that various resonances excited in the impacted spheres produce the higher-frequency oscillations that follow. Resonances of uncracked balls were related to a particular, spheroidal mode of vibration whereas resonances of cracked balls are attributed to "tuning fork" modes of vibrations. Both a laboratory and an industrial prototype that perform the sorting of cracked and uncracked grinder balls by using the differences in their acoustic properties were built and tested. A 97% success rate was achieved for 3 in. dia. balls. The device is being fitted to the production line. 9 Refs.

2605 Zanker, A., "Determining the Basic Design Parameters of Ball Mills"; Process Engineering, Vol. 66, No. 3, 1985, p. 63; Ref: 001

2617 Gupta, V.K., Zouit, H., Hodouin, D. (Univ. Laval, Fac. Sci. & Genie, Grp. Rech. Automat. Appl. Ind. Minerale, Quebec City, G1K 7P4, Quebec, Canada), "The Effect of Ball and Mill Diameters on Grinding Rate Parameters in Dry Grinding Operation"; Powder Technology, Vol. 42, No. 2, 1985, pp. 199-208; Ref: 023

2623 Stehr, N. (Draiswerke Gmbh., Speckweg 43-59, D-6800, Mannheim, Waldhorf 3, Fed. Rep. Ger.), "Fine Grinding of Coal Water Mixtures in Ball Mills"; Chemie Ingenieur Technik., Vol. 57, No. 2, 1985, pp. 162-163; Ref: 003

2718 Burns, R.S., Erskine, J.G. (Bougainville Copper Ltd., Papua, New Guinea), "Experience with Large Diameter Ball Mills at Bougainville Copper Ltd."; Miner. Metall. Process, Vol. 1, No. 1, May 1984, pp. 15-22; 9 Refs: MMPRE; A533; A802

1 - Ore Treatment - Crushing and Grinding; Grinding Mills - Ball Milling; Crushing and Grinding - Efficiency; Pump Overloading; Cyclone Overloading; Graded Ball Charge; Liner Design; Ball Mills

Treat: A (Applications); X (Experimental)

The performance of the nine 5.5 m diameter "multiplied by" 6.4 m mills initially installed at Bougainville Copper Ltd. in the North Solomons province of Papua New Guinea, did not meet the laboratory and pilot plant derived design expectations. During the post-commissioning period, inefficient grinding of coarse material resulted in a build-up of large circulating loads and led to reduced throughputs because of pump and cyclone overloading. Installation of larger pumps and cyclones and development of an improved circuit control philosophy alleviated material handling problems and permitted higher tonnages to be attained. Developments in classification and mill speed-up, together with a finer ball mill feed size and substantial improvements to mill availability have further increased plant capacity. Current development work includes trials of graded ball charges, different liner profiles, and assessment of scalping/regrind proposals.

2719 Whiten, W.J., Kavetsky, A. (Univ. of Queensland, Brisbane, Aust.), "Studies on Scale-up of Ball Mills"; Miner. Metall. Process, Vol. 1, No. 1, May 1984, pp. 23-28; 10 Refs: MMPRE;

A533; A921; A802; 1 - Crushing and Grinding - Mathematical Models; Ore Treatment - Crushing and Grinding; Grinding Mills - Ball Milling; Large Ball Mills; Scale-up Mill Behaviour; Perfect-Mixing Mill Mode; Coarse Particle Breakage; Power Inefficiency

Treat: A (Applications); T (Theoretical)

The impetus for the work described in this paper was provided by difficulties being reported by some operators in obtaining design throughputs in large diameter ball mills. In some cases, it seems that the usual methods of ball mill scale-up

based on the bond work index seriously overestimate the throughput of large diameter ball mills; in other cases, these methods seem to have been used successfully in the design of grinding circuits containing such mills. Data from ball mills with a wide range of diameters are analyzed using detailed mathematical/numerical models. Analysis shows the relative power inefficiency of large ball mills is due to their inefficient breakage of coarse particles. The models developed can be used to scale-up mill behaviour.

2721 Sacris, E.M., Cawagdan, V.G., (Benguet Corp., Dizon Copper Gold Operation, San Marcelino, Philipp.), "Grinding Performance of the Ball Mill at the Dizon Operation of Benguet Corporation"; Miner. Metall. Process, Vol. 1, No. 3, Nov. 1984, pp. 204-209; 2 Refs.: ISSN 0020-0891; MMPRE;

A533; A802; A504; 1 - Ore Treatment - Crushing and Grinding; Grinding Mills - Ball Milling; Crushing and Grinding - Efficiency; Copper Gold Mines and Mining - Philippines; Secondary Ball Mill Conversion; Mill Operating Parameters; Cyclone Pump Size; Ball Mill Circuit Control; Cyclone Orifices

Treat: A (Applications); X (Experimental)

The mine of Benguet Corp.'s Dizon Copper Gold Operation is located in San Marcelino in the province of Zambales, Philippines. The performance of the grinding circuit of the mine from the initial stages of operation to the present, is discussed. The mill efficiency as measured by the bond grindability data and the operating work index is presented. Significant improvements in throughput were achieved by instituting equipment changes and process modifications within the grinding circuit. Grind improvements were achieved with enlargement of cyclone spigots, grinding at reduced densities, and decreasing the opening of the ball mill discharge. Additional grinding capacity was realized by converting the concentrate regrinding mill into a secondary ball mill.

Austin, L.G., Klimpel, R.R., Luckie, P.T.

(Pennsylvania State Univ., University Park, PA, USA), "Process Engineering of Size Reduction: Ball Milling"; Process Eng. of Size Reduct.: Ball Milling Publ, by Soc. of Mining Engineers of AIME, New York, NY, USA, 1984, 561 p.; Refs: ISBN 0-89520-421-5

A533; A802; A921; 1 - Grinding Mills - Ball Milling; Crushing and Grinding - Mathematical Models; Tumbling Ball Mills; Size Reduction

Treat: G (General Review)

This book is intended as a compact introduction to the mathematical treatment of the unit operation of size reduction by mechanical means. that is, the sizing, behaviour, and performance of grinding circuits using ball mills, and mechanical engineering aspects of mill design are mentioned only as they relate to the process design. Major objectives of this book are to present this treatment in depth and to show the correlations and divergences of its results from the older treatments. This volume deals almost exclusively with tumbling ball mills performing size reduction on brittle materials, although many of the concepts will be applicable to other types of mills.

2741 Rolf, Lutz, Vongluekiet, Theudchai (Tecnische Univ. Berlin, Inst. fuer Chemiengenierutechnik, Berlin, West. Ger.), "Measurement of Energy Distributions in Ball Mills"; Ger. Chem. Eng., Vol. 7, No. 5, Sept. 1984, pp. 287-292; 17 Refs; ISSN 0343-5539; GCETD

A802; 1 - Crushing and Grinding; Ball Mills

A new measuring technique has been developed to obtain quantitative information about energy distributions in ball mills. Instrument balls are used which are identical to the normal grinding balls, regarding size, mass and surface characteristics. The first experiments showed the possibility of a routine utilization of this measuring technique. Diverse information could be obtained about the motion phenomena and energy distribution in a ball mill in relation to the speed of rotation, the ball charge and the influence of lifting devices installed inside the mill. The application of this measuring technique will make it possible to optimize the energy distribution for the material to be ground.

2826 Ohno, T., Aoyama, A., Goto, M., Suzuki, T., Katoaka, A., "The Ball Mill Operation at Reduced Rate (52% of the Maximum Rate) at Kamaishi Extraction Works"; J. Min. Metall. Inst. Jpn. (Apr. 1984), Vol. 100, No. 1164 pp. 334-338; ISSN 0369-4194

41; Ball Milling; Energy Conservation

The saving of electricity in the extraction department, which consumes 73% of the total electricity used at the mine, has a vital influence on the management of the mine. Various electricity saving measures, such as the intensification of operating, simplification of extraction processes, reduction in the number of operating machines, selection of less electricity consuming machines, change in the rate of rotation of various parts, have been introduced with varying

results. Guided by the policy of how to achieve the optimum result with the heat extension, the ball mill, which is the largest electricity consumer during the extraction process, was made to operate at a reduced rate of rotational speed. With the 8 ft x 4 ft tricon mill, it was found that the motive power of the mill is proportional to the 1.5th power of rate of rotation,thus proving the economical effectiveness of reduced rate of operation. This, moreover, reduced noise from the machines, contributing to the improvement of the working environment.

2834 Fuerstenau, D.W., Abouzeid, A.Z.M., (Univ. Calif. Berkeley, Dept. Mat. Sci. & Mineral Engn., Berkeley, CA, 94720), "Scale-up of Lifters in Ball Mills"; International Journal of Mineral Processing, Vol. 15, No. 3, 1985, pp. 183-192; Ref: 011 Microfiche

2849 "Ball Milling Techniques, 1970 - October 1985 (Citations from Engineering Index Data Base) (National Technical Information Service, Springfield, VA)"; PB85-869113/XAD, Oct. 85, 139 p. Rept. for 1970 - Oct. 85. Supersedes PB84-873132

13h: 41e*; 94G; 88E; *Bibliographies; *Grinding (Comminution); *Ball Milling; NTISNTISH; NTISNERACD

This bibliography contains citations concerning wet and dry ball milling techniques with various particulate materials. Design, material selection, engineering parameters, performance characteristics and control systems for ball mills are discussed. (This updated bibliography contains 207 citations, 34 of which are new entries to the previous edition.)

2850 Freedman, Marc R., Kiser, James D., Herbell, Thomas P. (NASA, Lewis Research Cent., Cleveland, OH, USA), "Factors Influencing the Ball Milling of SI//3N//4 in Water";, NASA Tech. Memo, 86932, 1985, 13 p.; 19 Refs; ISSN 0499-9320; NATMA

A804; A604; A533; A802; 1 - Silicon Compounds - Grinding; Grinding Mills - Ball Milling; Ball Milling of Silicon Nitride: Powder Comminution

Treat: X (Experimental)

A statistical study of the ball milling of SI//3N//4 powder in SI//3n//4 hardware was undertaken to understand how the resulting increase in specific surface area is related to solids loading and mill speed. An attempt to optimize milling conditions was also made. The degree of comminution was more dependent upon solids loading than mill speed. A practical grinding limit between 0.5 and 0.75 μm m was

achieved in 144 hr independent of solids loading. Ball mill wear and media wear were independent of both solids loading and mill speed.

(C) Grinding (ii) Autogenous, Semi-Autogenous, Pebble Milling

2515 Sinel'nikova, L.N., (USSR (SU)), "Development of Autogenous Grinding Technology at Non-Soviet Concentration Mills"; Tsvetn. Met. (Moscow), No. 1, 1984, pp. 96-102; ISSN 0372-2929; TVMTA

CA154000; Review Ore Autogenous Grinding, Copper Ore Autogenous Milling Review

Zinc Ores, Lead Ores, Copper Ores, Ore Treatment

2810 Pauw, O.G., King, R.P., Garner, K.C., Van Aswegen, P.C. (Gencor, Metallurgical Services Dept., S. Afr.), "Control of Pebble Mills at Buffelsfontein Gold Mine by Use of a Multivariable Peak-Seeking Controller"; J. S. Afr. Inst. Min. Metall., Vol. 85, No. 3, Mar. 1985, pp. 89-96; 15 Refs: ISSN 0038-223X; JSAMA

A533; A504; A731; 1 - Gold Ore Treatment - Crushing and Grinding; Gold Mines and Mining - South Africa; Control Systems, Multi-variable - Applications; Pebble Mills; Peak-Seeking Controller

Treat: A (Applications); X (Experimental)

The relationships between mill power and pebble load, bulk density of the load, and circulating load were investigated in the grinding circuit. The results were used for the development of multivariable peak-seeking controllers. The control algorithms are described.

(C) Grinding (iii) Tower Mills and Other

2511 Gandolfi, E.A.J., Papachristodoulou, G., Trass, O. (Univ. Toronto, Dept. Chem. Engn. & Appl. Chem. Toronto, M5S 1A4, Ontario, Canada; Gen. Comminut. Inc., Don Mills, M3B 2M3, Ontario Canada), "Preparation of Coal Slurry Fuels with the Szego Mill"; Powder Technology, Vol. 40, No. 1-3, 1984, pp. 269-282; Ref: 010

2518 Cleeman, J., "Influence of Mill Ventilation on Grinding Efficiency"; Zement Kalk Gips, Vol. 37, No. 12, 1984, pp. 628-635; Ref: 004

2529 Nakamura, N., Tojo, K., Mukai, S. (Ishikawajima-Harima Heavy Industries Co. Cement Plant Div. Jpn), "Air-Swept Raw Material Grinding Mill Installation in Abu-Dhabi"; Cim.Beton. Platres Chaux No. 2, 1984 - 747 1984, pp. 73-76; ISSN 0397-006X; CBPCD

1 - Cement - Raw Materials; Grinding Mills - Moisture Control; Thermal Effects - Efficiency; Air-Swept Mill; Drying Compartment; A412; A421

An air-swept grinding mill of 170 t/h throughput is operating free of trouble in a 500,000 t/y cement plant in Al-Ain, Abu-Dhabi, United Arab Emirates. The concept of air-swept mill with drying compartment, adopted for this installation, is superior to other concepts of drying and grinding equipment in terms of thermal efficiency and specific power consumption, for materials of high moisture content up to 13%. The simplicity of structural design and the small number of driven machinery is another advantage of this type of equipment, which is consequently characterized by low initial outlay, simplified and economic maintenance, as well as low consumable expenditures.

2530 Anon., "Mitsubishi-Ce Raymond Roller Mill for Delayed Petroleum Coke Grinding"; Tech. Rev. Mitsubishi Heavy Ind., Vol. 21, No. 2, June 1984, pp. 170-171; ISSN 0026-6817; TRMHA

1 - Coke - Petroleum; Grinding Mills - Applications; Roller Mills; A524; A513; A802

The Mitsubishi-Ce Raymond Roller Mill, first manufactured by CE Raymond Division, USA, is a vertical pulverizer that exhibits excellent characteristics for all kinds of materials, with respect to performance, operation and maintenance. The mill can pulverize petroleum coke as finely as to pass more than 99.9 p through 325 mesh size. This performance is sufficient to be applied in the pulverized combustion systems of boilers and kilns. The structure and features of this roller mill are reported in this paper.

2534 Stehr, N., (Inst. Mech. Verfahrenstech., Tech. Univ. Braunschweig, Braunschweig, Fed. Rep. Ger., D-3300 (DE)), "Residence Time Distributions in a Stirred Ball Mill and Their Effect on Comminution"; Chem. Eng. Process, Vol. 18, No. 2, 1984, pp. 73-83, CENPE

CA148003; Residence Time Distribution Ball Mill, Grinding Stirred Ball Mill, Time Residence Grinding Ball Mill Size Reduction, Time

2600 Zisselmar, R. (Khd. Humboldt Wedag Ag, Cologne, West Ger.), "Dimensioning of Tubular Vibration Mills on the Basis of

Laboratory Tests / Die Dimensionierung von Rohrschwingmuehlen auf der Grundlage von Laborversuchen"; Aufbereit Tech., Vol. 25, No. 10, Oct. 1984, pp. 553-562; 5 Refs; ISSN 0004-783X; AUFTA

A802; 1 - Grinding Mills - Design

Treat: X (Experimental)

For fine and very fine grinding of materials of different degrees of grindability unbalance-driven vibration mills equipped with two paraxially arranged grinding cylinders are especially suited. Their wide range of application permits the solution of a great number of grinding problems. For adaptation to a specific grinding problem, the tubular vibration mill can be equipped and adjusted for each particular purpose. Designing on a mere theoretical basis is not possible at present; it is absolutely necessary to perform laboratory tests. During such tests the optimal grinding process is determined in each specific case by varying the equipment and setting parameters, e.g., the type and material of the grinding media. The filling capacity, the amplitude, the frequency etc. on this basis, in connection with the experience gained in operating a great number of mills the tubular vibration will most appropriate both technically and economically for the specific requirement can be determined. In German and English.

2609 Gotsis, C., Trass, C. (Penn State Univ., Mat. Res. Lab. University Pk., PA 16802; Univ. Toronto, Dept. Chem. Engn. & Appl. Chem., Toronto, M5S 1A4, Ontario Canada), "Performance of the Szego Mill in Dry Grinding Coal and Wheat"; Powder Technology, Vol. 41, No. 3, 1985, pp. 287-294; Ref: 007

(C) Grinding (iv) Wear and Liners

2502 Tolley, W.K., Nicholas, I.L., Huiatt, J.L. (Dep. Interior, USA, (US)), "Corrosion Rates of Grinding Media in Mill Water"; Rep. Invest. - U.S. Bur. Mines, No. (RI 8882), 1984, p. 10; ISSN 0096-1922; XBMIA CA155010; Steel Ball Mill Corrosion Grinding WaterSize Reduction Apparatus, 92537-27-4; 12672-15-0; 11068-68-1; 92537-28-5; 92537-29-6

2627 Austin, L.G., Klimpel, R.R. (Pennsylvania State Univ., University Park, PA, USA (US)), "Ball Wear and Ball Size Distributions in Tumbling Ball Mills"; Powder Technology, Vol., 41, No. 3, 1985, pp. 279-286; ISSN 0032-5910; POTEB

CA148003; Ball Wear Size Distribution Tumbling Mill

Size Reduction Apparatus

2716 Moore, J.J., Iwasaki, I., Natarajan, K.A., Perez, R., Adam, K., "The Effect of Grinding Ball Composition and Mineral Slurry Environment on Grinding Media Wear"; Tribology in Mineral Extraction - War on Wear, Nottingham, UK, 17-19 Sept. 1985; Mechanical Engineering Publications, P.O. Box 24, Northgate Avenue, Bury St. Edmunds, IP32 6BW, UK, 1984, pp. 215-226

31; SCL; ST; SSM; SSA; FED; Ball Mills; Spheres, Mechanical Properties, Steels, Mechanical Properties, Cast Iron, Mechanical Properties, Wear, Slurries, Ores, 1020:SCL; FE-0.89C-1MN-0.5CR-0.13NI-0.25CU-0.002V:ST; FE-1. 1C-17CR-0.75M0;SSM; FE-0.08C-2MN-1SI-19CR-9NI: SSA; FE-3C-0.4MN-1SI-19.6CR-0.14NI-CU-MO:FEC; See also: 8507-72-0352

Grinding media wear tests have been conducted using a range of ball compositions and slurry environments for both sulfide and oxide ores and the wear data correlated with electrochemical measurements made on similar mineral-metal systems. 13 Ref.

2717 Natarajan, K.A., Riemer, S.C., Iwasaki, I. (Indian Inst. of Science, Dept. of Metallurgy, Bangalore, India), "Corrosive and Erosive Wear in Magnetic Taconite Grinding"; Miner. Metall. Process, Vol. 1, No. 1, May 1984, pp. 10-14; 7 Refs; IMMPRE

A533; A421; A539; A641; A545; A422; 1 - Iron Ore Treatment - Crushing and Grinding; Grinding Mills - Wear; Corrosion; Erosion; Steel - Wear; Materials Testing; Abrasive Wear; Grinding Balls; Corrosion Wear; Erosive Wear; Magnetic Taconite

Treat: X (Experimental)

The relative significance of corrosive and erosive wear in magnetic taconite grinding is examined. The influence of different types of aeration (nitrogen, air, and oxygen) on ball wear was established for mild steel and high carbon low alloy steel balls. Ball wear data from dry and wet grinding tests are compared with those obtained in the presence of an organic solvent that does not promote electrochemical corrosion. Marked ball grinding tests and electrochemical

measurements involving ball material and magnetite electrodes indicate that contribution from oxygen toward wear (corrosive wear) is relatively small, and abrasive wear appears to be significant. Rheological properties of the slurry appear to have an important bearing on the abrasive wear of grinding balls.

2723 Iwasaki, I., Natarajan, K.A., Riemer, S.C., Orlich, J.N. (Miner. Resour. Res. Cent., Univ. Minnesota, Minneapolis, MN, USA (US)), "Corrosive and Abrasive Wear in Ore Grinding"; Wear Mater., 1985, pp. 509-518; ISSN 0192-4990; WMATD

CA155010; Ore Grinding Ball Corrosion Abrasion; Taconite Grinding Ball Corrosion Abrasion; Quartzite Grinding Ball Corrosion Abrasion; Nitrogen Grinding Ball Corrosion Abrasion; Oxygen Grinding Ball Corrosion Abrasion; Pyrrhotite Grinding Ball Corrosion Abrasion; Magnetite Grinding Ball Corrosion Abrasion; Ethylene Glycol Grinding Ball Corrosion Abrasion

Quartzite; Iron Formations; Ore Treatment: 1309-38-2; 1310-50-5; 7727-37-9; 7782-44-7; 107-21-1; 67-56-1; 11109-50-5; 97696-63-4; 12725-36-9

2729 Jones, Denny A. (Univ. of Nevada, Reno, Dep. of Chemical & Metallurgical Engineering, Reno, NV, USA), "Corrosive Wear in Wet Ore Grinding Systems"; J. Met., Vol. 37, No. 6, June 6, 1985, pp. 20-23; 20 Refs: ISSN 0022-2674; JOMTA

A533; 1 - Ore Treatment - Crushing and Grinding; Grinding Mills - Ball Milling; Corrosive Wear; Wet Grinding

Treat: G (General Review)

Wear processes in ball and rod mills have recently received attention in order to increase efficiency and conserve grinding media. Direct removal of metal from the grinding media surface by abrasive wear occurs in both dry and wet grinding. Additional corrosive wear is apparent during wet grinding in which less restraining corrosion product films are abraded away. Inhibitors and higher pH solutions, in which corrosion product films are more tenacious, improve wear resistance. Softer surfaces are less resistant to corrosive wear, suggesting that film formation and subseqent abrasion on newly furrowed surfaces must be a factor.

2817 Pitt, C.H., Chang, Y.M. (Metall. Dep., Univ. Utah, Salt Lake City, UT, USA (US)), "Electrochemical Determination of Erosive Wear o. High Carbon Steel Grinding Balls"; Miner. Metall. Process., Vol. 2, No. 3, 1985, pp. 166-173; ISSN 0747-9182; MMFRE

CA172006; Electrochem. Detn. Wear Grindability Ball; Carbon Steel Ball Corrosion Erosion

Size Reduction Apparatus; Corrosion; Erosion; 14808-60-7; 1308-56-1; 11121-90-7

2837 Gangopadhyay, A.K., Moore, J.J., "The Role of Abrasion and Corrosion in Grinding Media Wear";, Wear (1 July 1985), Vol. 104, No. 1, 49-64; ISSN 0043-1648

41; Ball Milling; Grinding Abrasion; Wear

A range of ferrous grinding media compositions was subjected to laboratory marked ball wear tests in an ongoing research program at the Mineral Resources Research Center which was aimed at elucidating the responsible wear mechanisms during the grinding of minerals. Most of the wear data in this paper were obtained using a model quartz-pyrrhotite mineral slurry but these have been supplemented, where appropriate, with a small amount of data from wear tests on taconite ore and a Cu-Ni gabbroic ore. The role of abrasive and/or corrosive wear was determined by comparing the wear rates which result under a range of grinding atmospheres, i.e. oxygen, nitrogen or compressed air, flushing through a laboratory mill of 8 in. dia. coupled with examination of ball surfaces after grinding using scanning electron microscopy. 12 Ref.

2845 Menacho, J.M., Concha, F., "Phenomenological Model of Ball Wear in a Tumbling Mill";, 15th International Mineral Processing Congress (15th Congress International de mineralurgie), Vol. 1, Cannes, France, 20-9 June, 1985, Edition Gedim, 19, rue du Grand-Moulin, 42029 St.-Etienne, Cedex, France, 1985, pp. 157-168

41; Ball Mills; Wear Rate; Spheres, Mechanical Properties, Mathematical Models; Particle Size Distribution; Flotation
See Also: 8510-72-0534

Using a population balance approach a model for the ball wear in a tumbling mill is developed. The model predictions of ball size distributions show excellent agreement with experimental data obtained from three different industrial mills. A scheme is proposed for determining the ball charging procedure that would maximize the production of particles of optimum size for flotation/unit energy consumed. 32 Ref.

1985 (D) CLASSIFICATION

2512 Burghardt, O, Mertins, E., Jones, Michael J., (Ed.), Gill, P. (Ed.), (Studienges. Eisenerzaufbereitung, Liebenburg, Fed. Rep. Ger., (DE)), "Heavy Media Cycloning of Non-Ferrous Ores in the Size Range 20 MM"; Miner. Process. Extr. Metall., Pap. Int. Conf., 1984, pp. 355-367; 52VSA; Pub: Inst. Min. Metall., London, UK

CA154001; Ore Sepn. Heavy Media Cyclone, Hematite Concn. Heavy Media Cyclone, Lead Zinc Ore Concn. Cyclone, Chromium Ore Concn Cyclone

Ore Treatment, Zinc Ores, Chromium Ores, Lead ores, 1317-60-8

2514 Samosii, A.P., Khairulina, S.T., "Introduction of Hydrocylones with an Extended Cylindrical Part into the First Stage of Grinding";, Tsvetn. Met., 1984, (6), pp. 88-89; ISSN 0041-4891

41; Ores, Beneficiation; Grinding (Comminution); Hydrocylones, Design

Investigation of the effectiveness of using a hydrocyclone with an extended cylindrical part in the first stage of grinding was conducted in two stages; determination of the optimum operating conditions of the standard and the extended hydrocyclone, followed by comparative tests of their operation. The extended hydrocylone was based on the standard GTS-500 hydrocylone. An experimental design was used in the first stage of the investigation. Replacement of the standard by the elongated hydrocylone made it possible to increase the yield of -0.074 mm fraction by 1.7%, to increase the output of the grinding unit by 2.5% and to reduce the specific consumption of electric energy by 3.8%.

2519 Husemann, K., Haubold, S., Dombrowe, H., Eibisch, R., Clemens, P. (Forschunginst Aufbereitung Freiberg, Fed. Rep. Ger.), "Grinding Media Classification in Tube Mills"; Zement Kalk Gips, Vol. 37, No. 12, 1984, pp. 636-641; Ref: 007

2610 Kuga, Y, Koga, J., Yamaguchi, K. (Inst. Phys. & Chem. Res., Wako Saitama 35101, Japan: Hokkaido Univ., Dept. Appl. Chem., Sapporo, Hokkaido 060 Japan), "Size Distribution of Products Pulverized by a Screen Mill"; Powder Technology, Vol. 41, No. 3, 1985, pp. 273-277; Ref: 007

2611 McIvor, R.E. (Linatex Canada Inc., Montreal, Que. Can), "Material Balance Calculation Procedure for Grinding Circuit Hydrocylone Selection"; CIM Bull., Vol. 77, No. 872, Dec. 1984, pp. 50-53; 12 Refs.; ISSN 0317-0926; CIBUB

A533; A723; 1 - Ore Treatment - Classifiers; Hydrocylones

Treat: X (Experimental)

Process specifications for classification system design for closed circuit grinding are identified. A computer-assisted, mass balance procedure for estimation of material size distributions and required hydrocyclone separation performance is presented.

2613 Lopatin, A.G., "Actual Structure of Flows in Hydrocyclones and Ways of Improving Their Operation"; Tsvetn. Met. (1984), (8), pp. 99-102; ISSN 0041-4891

41; Centrifugal Classifiers, Hydrocyclones; Hydrodynamics; Fluid Flow; Turbulence

By means of laser techniques, pictures of the actual flows of liquid that develop in classifying hydrocyclones were obtained. The turbulent nature of the flows and the limits of their propagation were revealed. The structure of the flows was studied.

The complex structure of upward flow and the occurrence of circulation in the hydrocyclone were established. On the basis of the actual hydrodynamics of hydrocyclones, ways of improving their operation are indicated.

2614 Bukayt G.B. et al., "Use of Harp-like Grids on Screens in Closed-Cycle Crushing Systems"; Tsvetn. Met. (1984), (8), pp. 103-105; ISSN 0041-4891

41; Ores, Beneficiation; Crushing; Screens (Sizing), Design

An examination is made of the results of tests of a new type of screening surface - harp-like grids with rectangular cells of 12 mm width-in-closed cycle conditions during screening of ore materials. The service life of harp-like grids is roughly the same as standard grids with square cells. The expediency of introducing harp-like grids is discussed. It is recommended that they be used in processing of moist and clayey ores.

2619 Standish, N, Meta, I.A., (Univ. of Wollongong, Dept. of Metallurgy, Wollongong, Aust.), "Some Kinetic Aspects of Continuous Screening"; Powder Technology, Vol. 41, No. 2, Feb. 1985, pp. 165-171; 6 Refs; ISSN 0032-5910; POTEB

A533; A605; A802; 1 - Iron Ore Sinter - Processing; Screens and Sieves - Performance; Iron Ore Treatment - Screening; Continuous Screening; Batch Sieving; Oversize Particles

Treat: T (Theoretical); X (Experimental)

Continuous screening of ferrous sinter mixtures was studied in a laboratory screen (310 "multiplied by" 600) incorporating continuous weighing of the underflow and overflow streams with the aim of checking the applicability of batch sieving results to continuous screening. The results of the study show that the two operations are comparable in all respects if deck length in continuous screening and time in batch sieving are interchanged. The effect of oversize particles is found to be beneficial in speeding up the screening of near-mesh material. Calculated screening rate constants with and without the presence of oversize, unfortunately, also parallel the results of batch sieving and this problem of theory is, therefore, still unresolved.

2625 Doheim, M.A, Ibrahim, G.A., Ahmed, A.A., (Univ. Assiut, Fac. Engn. Dept. Min. & Met. Engn, Assiut, Egypt), "Rapid Estimation of Corrected Cut Point in Hydrocylone Classification Units" International Journal of Mineral Processing, Vol. 14, No. 2, 1985, pp. 149-159; Ref: 015

2706 Moir, Douglas, N., (Sep. Processes Serv., Warren Spring Lab, Stevenage, UK (GB)), "Selection and Use of Hdrocylones"; Chem. Eng. (Rugby, Engl.), Vol. 410, 1985, pp. 20-25, 27; ISSN 0302-0797; CMERA

CA147002; Hydrocylone Selection Sizing Separators

2713 Napier-Munn, T.J., "The Mechanism of Separation in Dense Medium Cyclones"; 2nd International Conference on Hydrocylones, Bath, UK, 19-21, Sept. 1984, BHRA, The Fluid Engineering Centre, Cranfield, Bedford MK43 0AJ, UK, 1984, pp. 253-280

45; Ferrosilicon; Updgrading; Dense Media Separators; Hydrocyclones; See Also: 8507-72-0348

Tests were carried out with ferrosilicon media in a 104 mm x 20 deg cyclone of constant geometry to examine the behaviour of the medium and its influence on the intrinsic density separation. It was concluded that the correlation for the separation density, delta sub 50, previously derived for stable media did not apply. Instead, the delta sub 50 for a given particle size was found to be a simple function of the feed and underflow medium densities: delta sub 50 - A + B RHO sub F + C RHO sub U. The discrepancy between this and the relation, delta sub 50 = RHO sub U, obtained by other workers was attributed to the lack of a significant yield to underflow in the present work, and the corresponding lack of spigot crowding. A theoretical foundation for the prevailing

value of RHO sub U was developed which successfully described its dependence upon operating variables such as flowrate, feed density and medium stability and viscosity. Delta sub 50 was found to decrease with increasing medium viscosity, and although classification of the medium did occur, its characteristics differed in some respects from those normally encountered in hydrocyclone classification. Differences of trends for milled (irregular shaped) and atomised (spherical shaped) ferrosilicon media were observed, and it was concluded that the characteristics and behaviour of the medium are process-determining.

2714 Svarovsky, L., "Evaluation of Clarification Performance of a Two-Stage Hydrocyclone System"; BRHA, The Fluid Engineering Centre, Cranfield, Bedford MK43 OAJ, UK, 1984, pp. 359-370

41; Hydrocyclones; Clarifiers; See Also: 8507-72-0348

Small dia. hydrocyclones are well suited for clarification duty because their operating cut size can be as low as 2 microns. In a two-stage system, this limit can be lowered still further and the purpose of this work was to establish the following: (1) the bottom limit in cut size achievable, (2) the optimum operating conditions and installation, (3) whether the ultimate performance of the system can be predicted from the grade efficiency curves of the individual units. The system chosen for the investigation was a single 10 mm hydrocyclone (AKW RWD 58) followed by another 10 mm cyclone (Mozley), in series, of higher efficiency design and smaller flow capacity. The 10 mm diameter was considered the smallest body diameter without blocking difficulties. 8. Refs

2715 Williamson, R.D., Bott, T.R., Newson, I.H., "Small Particle Separation in a Hydrocyclone"; 2nd International Conference on Hydrocyclones, Bath, UK, 19-21, Sept. 1984; BHRA, The Fluid Engineering Centre, Cranfield, Bedford MK43 0AJ, UK, 1984, pp. 317-380

41; Separators; Hydrocyclones; Hematite; Beneficiation; Mangetite; Beneficiation: See also: 8507-72-0348

An investigation of small particle separation has been carried out in a 10 mm diameter hydrocylone, using hematite, magnetite and silica particles. The results show that reducing viscosity and/or increasing pressure drop increases the efficiency of separation. Using low viscosity, modest pressure drops have yielded D sub 50K values as low as 1 MU M. The results for magnetite and hematite show that agglomeration is a determinent to separation. 6 Refs.

2818 Peterson, R.D., Herbst, J.A., "The Effects of Two-Stage Hydrocylone Classification on Mineral Processing Plant Performance"; Can. Metall. Q. (Oct.-Dec. 1984), Vol. 23, No. 4, pp. 383-391; ISSN 0008-4433

41; Chalcopyrite, Beneficiation; Screening (Sizing); Particle Size Distribution; Hydrocyclones; Computer Simulation

The effects of two stages of hydrocylone classification on many aspects of mill performance in a mineral processing plant were investigated with the use of a simulator. The simulator includes models for grinding and liberation, classification, and flotation. A typical mill flowsheet for processing chalcopyrite ore at the rate of 204 mt/h was simulated. Depending upon the cyclone configuration, two-stage classification can have a large effect, both positive and negative, on overall plant performance. With the proper cyclone configuration and water additions, fine-particle bypass of the cyclones can be decreased, resulting in lower circulating loads, lower percent solids in the cyclone underflow, higher rotation grade and recovery, and the possibility of higher feed capacity for the same mill. 15 Refs.

2819 Joergensen, Soeren Worre (F.L. Smith & Co.), "Develop High Efficiency Air Separator for Cement Grinding Systems"; Pit Quarry, Vol. 78, No. 1, July 1985, p cr 36-cr 50; 1 Ref: ISSN 0032-0293; PIQUA

A412; A901; 1 - Cement - Manufacture; Crushing and Grinding - Energy Consumption; SEPAX Separator

Treat: X (Experimental)

A new type of separator called the SEPAX has been developed by F.L. Smith & Co. Measurements carried out in a cement grinding plant in Spain have confirmed its high performance and large capacity, due mainly to effective dispersion of material fed from the mill to the riser duct which is fitted under the separator section. The separator is designed not only for the grinding of cement but also for other materials.

2830 Rogers, R.S.C., Brame, K.A., (Kennedy Van Saun Corp., Danville, PA, USA), "Analysis of the High-Frequency Screening of Fine Slurries"; Powder Technology, Vol. 42, No. 3, June, 1985, pp. 297-304; 12 Refs; ISSN 0032-5910; POTEB

A533; A605; 1 - Crushing and Grinding; Screens and Sieves - Analysis; Fine Slurries; Size Selectivity; Slurry Feed Rate

Treat: X (Experimental)

High-frequency screen tests of a number of different fine slurries are analyzed to determine the effect of slurry feed rate and weight percent solids on screen size selectivity values. Results of this analysis indicate that for the screen cloths tested, slurry feed rate has a negligible effect on size selectivity values but that increasing the feed solids concentration causes finer but less efficient particle size separation. The size selectivity data are analyzed to give values for the D//5//0, the sharpness index and apparent bypass parameters of a screen size selectivity equation. Approximate empirical relationships between these parameters and screen aperture size and slurry feed solids concentration are given, and an example of the use of the size selectivity equation in grinding-circuit simulations is presented.

2831 Kuga, Y., Ma, X.H., Koga, J., Endoh, S., Inoue, I. (Inst. Phys. & Chem. Res., Wako, 35101, Japan), "Measurement and Statistical-Analysis of Shape of Particles Comminuted by a Screen Mill"; Powder Technology, Vol. 44, No. 3, 1985, p. 281-290; Ref: 013

2842 Fang, Z., "Cyclo Fine Screen: A Newly Developed Classifying Device for Close-Circuit Fine Grinding of Complex Ores";, Edition Gedim, 19, rue du Grand-Moulin, 42029, St.-Etienne, Cedex, France, 1985, pp. 555-565

41; Tin Ores; Beneficiation; Tungsten Ores; Beneficiation; Comminution; Screening (Sizing; Fineness; See Also: 8510-72-0534

Construction of cyclo fine screen (CFS), its principle of classification and operation parameters are described. Laboratory and industrial-scale tests of the new equipment have been carried out on Sn and tungsten ores. The circulating load fed to mill is reduced because of higher classification efficiency and both steel and energy consumption can thus be saved. Due to less overgrinding of valuable mineral, CFS improves metallurgical results greatly. 5 Refs.

2846 Rantanen, S., Ryynan, S., "Multistage Centrifugal Classification Process in Grinding Circuits";, 15th International Mineral Processing Congress (15th Congress International de mineralurgie), Vol, I, Cannes, France, 2-9 June, 1985; Edition Gedim, 19, rue du Grand-Moulin, 42029, St.-Etienne, Cedex, France, 1985, pp. 179-187

41; Centrifugal Classifiers; Comminution; Classification; Efficiency; See Also: 8510-72-0534

A new classification method has been under development work in Outokumpu Oy, Finland, for the last few years concerning multistage centrifugal classification methods. Earlier, several attempts were carried out to improve classification efficiency by installing, e.g. another classifier to treat cyclone sands in grinding circuits. A novel method, where several classification stages have been realized in one classifier unit only is considered. From two to six consecutive separation stages have been studied in a laboratory scale and a three-stage classifier has been tested in an industrial scale. The performance of the studied classifiers measured by screen analyses and by capacities is presented. Also, the structure of the classifiers is shown by simplified drawings. 1 Ref.

2847 Shelton, D.C., "Regrind Mill Sizing"; 15th International Mineral Processing Congress (15th Congress International de mineralurgie), Vol, I, Cannes, France, 2-9 June, 1985; Edition Gedim, 19, rue du Grand-Moulin, 42029, St.-Etienne, Cedex, France, 1985, pp. 188-200

41; Screening (Sizing); Comminution; Molbydenum Ores, Beneficiation; See Also: 8510-72-0534

The reasons for regrinding intermediate sulfide ore beneficiation products are discussed. The methodology used for sizing primary ball mills is not necessarily applicable to regrind mill sizing. How regrind mills have been selected in the past, and a convenient technique for adequate and sufficiently accurate sizing are presented. The results of several regrinding mill surveys are included along with the experience of a large segment of the industry. It is concluded that the data available for most regrind mill sizing problems do not justify excessive mathematical accuracy. 5 Refs.

1985 (E) THEORY, KINETICS, MODELLING, FRACTURE

2521 Kurrer, K.E., Gock, E. (Tech. Univ. Berlin, Inst. Chem. Ingn. Techn. Str. 17 Juni 135 D-1000 Berlin 12 Fed. Rep. Ger.), "Internal Kinematics of Tubular Ball Mills", Chemie Ingenieur Technik., Vol. 57, No. 1, 1985, pp. 64-65; Ref: 000

2525 Standish, N., Meta, I.A (Univ. Wollongong, Dept. Met. Wollongong, NSW 2500 Australia); "Some Kinetic Aspects of Continuous Screening", Powder Technology, Vol. 41, No. 2, 1985, pp. 165-171; Ref: 006

2526 Gotsis, C., Austin, L.G. (Pennsylvania State Univ. Mineral Processing Section, University Park, PA, USA), "Batch Grinding Kinetics in the Presence of Dead Space, as in a Hammer Mill"; Powder Technology, Vol. 41, No. 1, Jan. 1985, pp. 91-98; 1 Ref. ISSN 0032-5910; POTEB

A802; A641; 1 - Crushing and Grinding - Theory; Grinding Mills - Mass Transfer; Batch Grinding; Hammer Mill

Treat: T (Theoretical)

It is shown that the presence of a dead space in a hammer mill leads to apparent non-first-order breakage of the top feed size in batch grinding. The equations to describe the disappearance of the top size are obtained, as are those for the total size distribution as a function of time. Examples are given of the effects caused by the magnitude of the dead space and the rate of mass transfer between the active and inactive space. The concepts may be applicable to other mills where dead space can exist.

2531 Kuga, Yoshikazu; Koga, Jiro; Yamagauchi, Kenji (Inst. of Physical & Chemical Research, Powder Technology Lab, Wako-Shi, Jpn), "Characteristics of Comminution Process of a Screen Mill. Calculation of Product Size Distribution"; Sci. Pap. Inst. Phys. Chem. Res. (Jpn.) Vol. 78, No. 1, March 1984, pp 6-11; 6 Refs; ISSN 0020-3092; SPIPA

A531; A533; 1 - Ore Treatment - Crushing and Grinding; Grinding Mills; Screen Mill; Particle Size; Brittle Materials; Feed Size Distribution

Treat: A (Applications); X (Experimental)

Comminution by a screen mill was considered to progress by impact of the hammers and lining plates in the mill and the size distribution of products was calculated theoretically under the following assumptions: the equation given by T. Tanaka et al. can be used to obtain the breakage probability. The breakage function can be expressed by Gaudin-Schuman equation, and the size distribution of particles in the mill is equal to that of product. The calculated results agreed well in general tendency with experimental ones on Soma sand and Toyoura sand.

2532 Viswanathan, K., Mani, B.P., (Indian Inst. of Technology, Dep. of Chemical Engineering, New Delhi, India), "Analysis of a Closed Grinding Circuit"; J. Powder Bulk Solids Technol., Vol. 8, No. 2, June 1984, pp. 25-28; 11 Refs.; ISSN 0147-698X; JPBTD

A533; A802; 1 - Crushing and Grinding; Grinding Mills; Distributed Fracture Model; Closed Circuit Grinding

Treat: T (Theoretical); X (Experimental)

The basic material balance equations for a closed grinding circuit are presented in matrix form. These are coupled with the distributed fracture model equations. The procedure of calculations is explained and illustrated with the aid of an example. The equations are easily programmable in a computer. Further work is needed to establish the effect of feed rate on the retention time of particles inside the grinding mill.

2601 Viswlanathan, K., Mani, B.P., "Scale-up Procedure for Grinding in Ball Mills Using the Distributed Fracture Model/Zerleinerung in Kugelmuehlen - Uebertragung eines Modells zur Ermittlung der Bruchverteilung in den Grossmasstab"; Aufbereit Tech. Vol. 25, No. 10, Oct. 1984, pp. 589-594; 12 Refs.; ISSN 0004-783X; AUFTA

A802; A921; 1 - Grinding Mills - Ball Milling; Mathematical Models

Treat: T (Theoretical)

The 'distributed fracture model' has been extended and generalized, and expressions have been presented for the distribution function for all six controlling mechanisms of fracture. A scale-up relation is proposed for the parameter C of the model. A simple experimental plus mathematical procedure is described by which to obtain the scale-up relation from laboratory experiments. The method of calculating the produce size distribution in industrial grinding mills becomes quite straight forward. This method requires much less computation than that required by other models available in the literature. In German and English.

2618 Gotsis, C., Austin, L.G., Luckie, P.T., Shoji, K. (Penn State Univ., Mineral Proc. Sect., University Pk, PA 16802; Kennedy Van Saun Corp, Danville PA 17821), "Modeling of a Grinding Circuit with a Swing-Hammer Mill and a Twin-Cone Classifier", Powder Technology, Vol. 42, No. 2, 1985, pp. 209-216; Ref: 009

2621 Kersting, Franz Josef (Fachbegiet Prozessautomatisier., Univ.-GH-Paderborn, Paderborn, Fed. Rep. Ger., 4790 (DE)), "Solution of the Differential Equation System of Size Reduction", Chem.-Ing.-Tech., Vol. 56, No. 12, 1984, p. 937; ISSN 0009-286X; CITEA

CA148003; Size Redn. Milling Model

Size Reduction

2624 Peterson, R.D., Herbst, J.A. (Univ. Utah Salt Lake City, UT 84112), "Estimation of Kinetic-Parameters of a Grinding-Liberation Model"; International Journal of Mineral Processing, Vol. 14, No. 2, 1985, pp. 111-126; Ref: 002

1985 (F) PROCESS ANALYSIS, EFFECTS

2500 Khopunov, E.A., Shatailov, Yu, L., (USSR (SU)), "Effect of the Physicomechanical Properties of Ores and Minerals on the Selectivity of their Liberation during Ball Milling"; Obogashch, Rud (Leningrad), No. 1, 1984, pp. 3-6; ISSN 0029-7623; OBOGA

CA154001; Magnetite Ore Grinding Mineral Liberation

Iron Ores, Minerals, 1309-38-2

2501 Verdes, S. (Budapest. Hung. (HU)), "Several Selected Process Operations in Grinding Plants", Aufbereit,-Tech., Vol. 25, No. 6, 1984, pp. 335-340; ISSN 0004-783X; AUFTA

CA158001; Grinding Control Evaluation Cement Industry Size Reduction, Cement

2505 Kawatra, S.K., Seitz, R.A. (Michigan Technological Univ. Houghton, Mich., USA), "Analysis of Wet Grinding Circuit Control Using Inferential Particle Size Measurement"; Trans. Am. Inst. Min. Metall. Pet. Eng. Soc. Min. Eng. AIME, Vol. 274, 1983, pp. 1962-1964; 14 Refs.; TAIAD

1 - Ore Treatment - Crushing and Grinding A533

This paper presents a review of some inferential sizing equations developed for pilot and industrial plants using regression analysis. An analytical development is presented showing how the general inferential sizing model arises from the nature of the classifier model. The relation between the general sizing model and individual equations is discussed.

2602 Forssberg, E., Zhai, H.X, (Lulea Univ. Technol., Div. Mineral Proc. S-95187 Lulea, Sweden), "Shape and Surface-Properties of the Particles Liberated by Autogenous Grinding", Scandinavian Journal of Metallurgy, Vol. 14, No. 1, 1985, pp. 25-32; Ref: 012

2607 Meloy, T.P. (West Virginia Univ., Morgantown, WV, USA), "Distribution of Original Surface Features During Comminution"; Powder Technology, Vol. 41, No. 2, Feb. 1985, pp. 197-202; ISSN 0032-5910; POTEB

A533; A802; A921; A804; A943; 1 - Crushing and Grinding - Mathematical Models; Powders - Surface Measurement; Particle Size Analysis; Comminution; Particle Size Distirbution; Surface Area; Edge Length; Edge Corners

Treat: T (Theoretical); X (Experimental)

When a brittle solid particle is comminuted, its surface features such as the original surface area, edge length and corners are distributed among the daughter fragments. From a set of simple assumptions, a model was made of the distribution of these particle surface features. The mass vs. size distribution is very steep for fragments that contain original surface features. However, the cumulative distribution of the original corners, edge length and surface area, versus fragments size all have a slop, similar to the size distribution curve of comminuted material. In addition, it has been shown that the total surface area of those fragments that contain some of the original surface area is constant, regardless of how finely these fragments may be ground.

2615 Bel'skii, A.A. (USSR (SU)), "Fraction Magnetic Analysis of Crushed Ore"; Obogashch. Rud. (Leningrad), No. 5, 1984, pp. 169-19; ISSN 0029-7623; OBOGA

CA154001; Iron Ore Magnetic Sepn. Beneficiation

Particle Size, Magnetic Field, Iron Ores

2629 Tangsathitkulchai, C., Austin, L.G., (Penn State Univ., Dept. Mineral Engn., Mineral Proc. Sect. University PK, PA 16802) "The Effect of Slurry Density on Breakage Parameters", Powder Technology, Vol. 42, No. 3, 1985, of Quartz, Coal and Copper Ore in a Laboratory Ball Mill", Powder Technology, Vol. 42, No. 3, 1985, pp. 287-296; Ref: 021

2702 Bortnikov, A.V., Mikhailova, N.S., Belikov, V.V., Belitskii, O.N. (USSR (SU)), "The Effect of Mechanical Activation in Ore Grinding on the Beneficiation and Hydrometallurgy", Obogashch. Rud (Leningrad), No. 6, 1984, pp. 6-10; ISSN 0029-7623; OBOGA

CA154001; Mech. Activation Ore Beneficiation Leaching, Copper Nickel Ore Grinding Flotation, Scheelite Grinding Flotation Leaching

Nickel Ores, Copper Ores, 497-19-8; 14913-80-5

2709 Hoffman, B., Bernhardt, C. (Akad der Wissenschaftern der DDR, Forschungsinstitut fuer Aufbereitung, Freiberg, East Ger.), "Energy Efficiency in Grinding Limestone with Monocarboxylic Acids / Zur Energieeffektivitaet bei der Mahlung von Kalkstein mit Monocarbonsaeuren"; Powder Technology, Vol. 41, No. 3, March 1985, pp. 295-300; 20 Refs.; ISSN 0032-5910; POTEB

A414; A482; A533; A802; A804; 1 - Limestone - Crushing and Grinding; Grinding Mills - Ball Milling; Organic Chemicals - Applications; Monocarboxylic Acids; Energy Efficiency; Milling Aids; Particle Size Distribution

Treat: X (Experimental)

Experiments were performed to study the influence of milling aids on comminution yield and energy efficiency of grinding operations. Limestone was ground in a ball mill using monocarboxylic acids as milling aids. The products were examined by measuring the particle size distribution. Optimal additions of the acids were determined. In German.

2712 Murat, M., El Hajjouji, A. (Lab. Chim. Phys. Appl. Environ., Insa Lyon, Villeurbanne, Fr, F-69621 (FR)), "Activation of Solids by Mechanical Grinding, Consequences for Calorimetric Investigation on the Hydration Rate of Orthorhombic Anhydrite"; Thermochim. Acta, Vol. 85, 1985, pp. 119-122; ISSN 0040-6031; THACA

CA167003; Calorimetry Grinding Solid Activation Kinetics, Hydration Kinetics Orthorombic Anhydrite Calorimetry, Calcium Sulfate Grinding Hydration Kinetics

Kinetics of Hydration, Size Reduction, Calorimetry, 7778-18-9

2720 Adam, K., Iwasaki, I. (Hellenic Chemical Products & Fertilizers Co., Athens, Greece), "Pyrrhotite-Grinding Media Interaction and its Effect on Floatability at Different Applied Potentials"; Miner. Metall. Process., Vol. 1, No. 1, May 1984, pp. 81-87; 10 Refs.; MMPRE

A533; A802; A539; A545; A801; 1 - Iron Ore Treatment - Crushing and Grinding; Grinding Mills - Corrosion; Steel Corrosion - Electrochemical; Ore Treatment - Flotation; Spectroscopic Analysis - Applications; Steel - Cathodic Protection; Controlled Potential Corrosion; Mineral Floatability; Pyrrhotite Protection; Corrosive Wear; Wet Grinding

Treat: X (Experimental)

During wet grinding the electrochemical interactions between grinding media and pyrrhotite not only accelerate media wear but also adversely affect the sulfide mineral's flotation response. A possible remedy of the adverse effects on floatability by applying electric potentials to grinding media was examined. Flotation tests, auger electron spectroscopy, and X-ray photoelectron spectroscopy were used to study pyrrhotite surface properties. Although anodic polarization of the steels increased metal loss by corrosion, pyrrhotite flotation recovery was increased. In the case of cathodic polarization, flotation recovery improved somewhat in a narrow range of overpotentials. At higher cathodic overpotentials, however, mineral floatability was progressively lowered although the corrosive wear of grinding media might be reduced.

2735 Cottaar, W., Rietema, K., Stemerding, S. (Dep. Chem. Eng. Eindhoven Univ. Technol., Eindhoven, Neth. (NL)), "The Effect of Interstitial Gas on Milling. Part 2", Powder Technology, Vol. 43, No. 2, 1985, pp. 189-198; ISSN 0032-5910; POTEB

CA148003; Milling Ball Mill Interstitial Gas

Size Reduction; Pressure

2740 Goodson, R., Larson, F., Sheehan, L. (SII Tungsten Carbide Mfg. Div., Smith Int. Inc., Tustin, CA, USA (US)), "Energy Input Monitoring During Attritor Milling"; Int. J. Refract. Hard Met., Vol. 4, No. 2, 1985, pp. 70-76; ISSN 0263-4368; IJRMD

CA146004; Tungsten Carbide Cobalt Attritor Milling

Cermets; Size Reduction; 37261-99-7; 11136-82-6

2743 Samarin, A.N., "The Effect of Chemically Active Substances on the Rough Grinding Process"; Soviet Engineering Research, Vol. 5, No. 2, 1985, pp. 73-75; Ref: 005

2744 Kiser, James D., Herbell, Thomas, P., Freedman, Marc R. (NASA, Lewis Research Cent., Cleveland, OH, USA), "Parametric Evaluation of Ball Milling of SiC in Water", NASA Tech. Memo, 86974, 1985, 16 pages; 16 Refs.; ISSN 0499-9320; NATMA

A804; A604; A533; A802; 1 - Silicon Carbide - Grinding; Grinding Mills - Ball Milling; Grinding Effectiveness; Specific Surface Area Increase
Treat: X (Experimental)

A statistically designed experiment was conducted to determine optimum conditions for ball milling "Alpha" -SiC in

matter. The influence of pH adjustment, volume percent solids loading and mill rotational speed on grinding effectiveness was examined. An equation defining the effect of those milling variables on specific surface area was obtained. The volume percent solids loading of the slurry had the greatest influence on the grinding effectiveness in terms of increase in specific surface area. As grinding effectiveness improved, mill and media wear also increased.

2820 Grigor'ev, N.P., Kostenki, A.R., Akulov, P.V., Chyvashova, L.A. (Chelyabinsk Metallurgical Combine, USSR), "Effect of Degree of Coal Grinding and Mixtures of Grinds on Coke Yield"; Coke Chem (USSR), No. 1, 1984, pp. 26-28; 7 Refs.; ISSN 0010-0501; COKCA

A524; 1 - Coal Preparation; Coke; Coal Grinding; Coke Yield; Charge Grinding

Treat: X (Experimental)

In previous work the only factor that was varied was the degree of charge-grinding; grinding properties were not varied. It is therefore of interest to investigate the dependence of coke yield on the extent to which certain coals and coal mixtures of various agglutinating powder are ground. The percent content of the coarse classes relative to each other and relative to the coals was established in equal mixtures. It is shown that the coke yield obtained when heating binary mixtures of medium and low volatile bituminous coals is presented. Data calculated using the additivity rule (K//A//D//D) and that referring to the coke yield from the mixtures are also presented. The coke yields found using the experimental method are always higher than those calculated using the additivity rule, no matter to what extent they have been ground. In the case of finely-ground mixtures, the greatest difference between experimental data and that calculated using additivity occurs for the mixture with the maximum amount of medium volatile bituminous coal.

2832 Zelikman, A.N., Medvedev, A,S., Rakova, N.N, "Mechanical Activation of Tungsten Minerals"; Tsvetn. Met. (1985), (4), pp. 61-64; ISSN 0041-4891

42; Tungsten, Extraction; Tungsten Ores, Beneficiation, Ball Milling, Leaching

The use of mechanical activation for accelerating hydrometallurgical processes is examined with reference to experimental results obtained for tungsten minerals (Scheelite and Wolframite). It is shown that not only does mechanical activation (ball milling) accelerate the breakdown of W minerals but it also significantly increases the

extraction of W into the final leached product, reduces the consumption of reagents, and lowers the process temp. In addition, mechanical activation provides new possibilities for the use of certain decomposing agents hitherto considered ineffective. 10 ref.

2838 Kanno, Y. (Gov. Ind. Res. Inst., Nagoya, Japan, 462 (JP)), "Properties of Silicon Carbide, Silicon Nitride (SI3N4) and Silica Ceramic Powders Produced by Vibration Ball Milling"; Powder Technology, Vol. 44, No. 1, 1985, pp. 93-97; ISSN 0032-5910; POTEB

CA157002; Grinding Vibration Ceramic Powder; Silica Powder Ultrafine Vibration Grinding; Silicon Carbide Powder Ultrafine Vibration Grinding; Nitride Silicon Vibration Grinding

Size Reduction; Ceramic Materials and Wares; 7631-86-9; 12033-89-5; 409-21-2

2841 Bandyopadhyay, A., Sanyal, P, Rao, T.C., Khare, R.N., "Process Analysis and Development of Model for the Grinding and Classification Circuit at Rakha Concentrator of Hindustan Copper Limited"; 15th International Mineral Processing Congress (15th Congress International de Mineralurgie), Vol. III, Cannes, France, 2-9 June 1985, Edition Gedim, 19, rue du Grand-Moulin 42029, St.-Etienne Cedex, France, 1985, pp. 144-153

41; Copper Ores, Beneficiation; Comminution; Classification; Mathematical Models; Hydrocyclones See Also: 8510-72-0534

In advanced countries, developments in on-line monitoring instruments and data processing have attained considerable maturity in the mineral industry, making the process of model development easier. In developing countries like India, the situation is much more difficult as there are several constraints. The introduction and stabilization of on-line monitoring facilities are yet to be done and hence it was decided to adopt the strategy of repeated hand sampling campaigns and analysis of the data collected based on fundamental principles. The successful development of the earlier hydrocylone model clearly vindicated the approach adopted. Modelling of the Cu ores grinding mills at Rakha as been undertaken and the details of the work done are presented. An approx. model has been developed and is being further refined by undertaking more sampling campaigns. The combined model of grinding and classification can now be utilised to operate the plant at max. possible throughput rate with the help of a microprocessor-based control scheme which is expected to be installed soon. 9 ref.

2844 Petruk, W, "Image Analysis Studies to Determine Liberations of Sphalerite, Chalcopyrite and Galena During Grinding of Fine Grained Pyrittic Zn-Pb-Cu-Ag Ores"; 15th International Mineral Processing Congress (15th Congres International de Mineralurgie), Vol. I, Cannes, Frances, 2-9 June 1985, Edition Gedim, 19, rue du Grand-Moulin, 42029 St.-Etienne Cedex, France, 1985, pp. 77-87

41; Ball Milling; Crushing; Sphalerite; Extraction; Galena; Extraction; Chalcopyrite, Extraction; Image Analysis See Also 8510-72-0534

Liberations of sphalerite, chalcopyrite and galena during grinding of pyritic Zn-Pb-Cu-Ag ores of the Bathurst area in New Brunswick, Canada, were investigated by image analysis studies on crusher, rod mill, ball mill and regrind ball mill feeds and discharges in the plant of Brunswick Mining and Smelting Corporation. The object was to determine whether there is a relationship between screen analysis and mineral liberations and to provide data for modelling grinding circuits. It was interpreted from image analysis studies of the uncrushed ore that the percentages of free sphalerite, chalcopyrite and galena in -40 mesh fraction would be 76, 62 and 45, respectively. Equivalent measured values on the ground ore were 82, 68 and 75. It was found that in ore brought from underground approx 4% of the sphalerite is as free grains. Very little liberation occurs in the cone crusher, but approx. 25% of the sphalerite is liberated in the rod mill; approx. 7% in the ball mill; and approx. 10% in the regrind ball mill. The proportions of the free sphalerite produced as -5 Mu M particles in the rod mill, ball mill and regrind ball mill are 25, 15 and 42%, respectively. Hence grinding of this ore produces a higher proportion of slimes in the rod mill and regrind ball mill than in the ball mill. The mineral liberation data correlate closely with the screen analyses of the mill feeds and discharges, therefore it is valid to develop mineral liberation models on the basis of screen analysis. 5 ref.

2848 Lin, I.J., Nadiv, S., "Mechano-Chemical Modification of Solid Particles through Fine Grinding"; 15th International Mineral Processing Congress (15th Congres International de Mineralurgie), Vol. I, Cannes, France, 2-9 June 1985, Edition Gedim, 19, rue du Grand-Moulin 42029, St.-Etienne Cedex France, 1985, pp. 223-230

41; Comminution; Shear Stress; Phase Transformations; Particles, Phase Transformations See also: 8510-72-0534

During comminution by grinding either chemical decomposition, polymorphic transformation, mechanical alloying or mechano-chemical synthesis may take place in single compound, or

mixture of powders. The material in the course of grinding is energetically activated by increasing both its surface and elastic-strain-free-energies. Then, energy relaxation follows by one of the above mentioned reactions, by overcoming the materials rigidity at ambient temp. through shear straining and further fracturing to below a characteristic "reaction triggering dimension". The theoretical aspects are discussed in detail, based on relevant scientific publications, and significant experimental evidences. The hierarchy of mechano-chemical processes in applied fields is shown, and some important applications are described. 27 ref.

1985 (G) PROCESS CONTROL, AUTOMATION

2504 Marks, W.R. (Rexnord Inc. Process Machinery Div., Milwaukee, Wis, USA), "Computer-Aided Torsional Analysis for Mill Drive Reliability"; Trans Am. Inst. Min. Metall. Pet. Eng. Soc. Min. Eng. AIME, Vol. 274, 1983, pp. 1849-1852; 9 refs. TAIAD

1 - Ore Treatment - Crushing and Grinding; Grinding Mills - Computer Applications A533; A723

Equations of torsional dynamics are developed for general mechanical drives. Consideration is given three solution types - the determination of undamped natural frequencies, the calculation of steady vibration amplititudes, and the prediction of transient torques during starting. Following a summary of the methods of calculating drive motor performance, the problems in making practical application of this theory are discussed. Experiences in both calculating and measuring the torsional loads on a large ball mill with dual synchronous motors are reviewed.

2520 White, Mark (Sconer Construction Equipment and Service Co., Tulsa, OK, USA), "Harnessing a Personal Computer to the Crusher"; Pit Quarry, Vol. 77, No. 5, Nov. 1984, pp. 54-59; ISSN 0032-0293; PIQUA

A533; A723; 1 - Crushing and Grinding - Computer Applications

Treat: M (Management Aspects)

In the crusher application program the computer will calculate the run of mine gradation for up to 20 size separations and five crushing stages.

2523 Ottergren, C., Leverance, N.C. (Allis Chalmers Solids Proc. Equipment Co., Svedala Arbra Ab Svedala Sweden; Allis Chalmers Solids Proc. Equipment Co., Appleton WI 54913), "Crusher Automation - Controllers or Computers"; Mining Engineering, Vol. 37, No. 1, 1985, pp. 74-75; Ref: 000

2616 Gelpe, T., Flament, F., Hodouin, D. (Energy Mines and Resources Canada, Ottawa, Ontario, Univ. Laval Quebec City, G1K 7P4, Quebec, Canada; Canada Cement Lafarge Ltd., Tech. & Res. Ctr., Montreal, Quebec, Canada), "Computer Design of Grinding Circuit Flowsheets - Application to Cement and Ore Processing"; Mining Engineering, Vol. 37, No. 3, 1985, pp. 241-248; Ref: 027

2801 Ottergren, Chris, Leverance, Neil C. (Allis-Chalmers Solids Process Equipment Co., Svedala, Swed.), "Crusher Automation - Programmable Controllers or Computers?" Pit Quarry, Vol. 77, No. 9, March 1985, pp. 49-51; ISSN 0032-0293; PIQUA

A533; A731; A732; A412; 1 - Crushing and Grinding - Control; Process Control; Crushed Stone Plants - Integrated Control; Programmable Controllers; Flow Rate Measurements; Alarm Functions

Treat; A (Applications)

The differences between programmable controllers and computers are becoming more and more diffuse but can be summed up in the following generalizations. A programmable controller (PC) uses logic circuits, fed with 0 or 1 signals, and are controlled by a program based on relatively simple relationships such as 'and', 'or' and 'not' instructions, timers, etc. Programming can be based on either logic symbols or simple PC "language". This makes the PC very easy to use for interlocking, complex start-up procedures, and sequential control routines. If the control requirement is more advanced, needing larger memory registers, mathematical functions, and proportional regulation, programming a computer is simpler and cheaper.

2802 Luder, R., Russenberger, W., "Automation of the Coal Grinding Plant at the Chekka Cement Works, Lebanon / Automation der Kohlenmahlanlage im Zementwork Chekka/Libanon", Zem Kalk Gips Ed. B, Vol. 38, No. 3, March 1985, pp. 131-134; ISSN 0722-4400; ZKGBD

A412; A731; A732; A524; 1 - Cement Plants - Control Systems; Process Control - Equipment; Coal Pulverizers - Control; Coal Comminution; Coal Storage Bins; Coal Crushing

Treat: G (General Review)

A central coal grinding plant of 60 T/hour capacity was commissioned at the Cheka works of Societe des Ciments Libanais (SCL), Lebanon, in the autumn of 1984. The new plant also comprises ship unloading, intermediate storage and homogenizing facilities, the firing units of the four rotary

kilns, and the appropriate handling and conveying installations. The automation system for the new plant comprises a central, two decentralized and a local control unit. Ready-made software modules were used for programming the control units. In German.

2833 Ottegren, C. (Svedala-Arbra Ab. Engineering Dep. Swed.), "Control and Automation"; Quarry Manage. Vol. 13, No. 3, March 1985, pp. 157-158, 161-162; QUMAE

A412; A402; A911; A731; A723; 1 - Crushed Stone Plants - Control; Control Systems, Programmed - Applications; Industrial Plants - Automation; Automatic Supervision

Treat: G (General Review)

Crushing plants involve different kinds of machines which must work together in an integrated process. Control of single functions like feed regulations, alarm functions, automatic setting regulation systems are becoming standard today. In multiple installations, only decreased electrical wiring costs can make it possible through the use of programmable controllers to pay for more sophisticated automation. If the control requirement is advanced, with larger memory registers, mathematical functions, proportional regulations, etc. programming is simpler and cheaper in a computer. The best solution for a complex control system is often to use PC systems for direct control, with a computer in overall command.

2836A Podobnki, Donald M., Dunstan, Philip, L., Santistevan, Eduardo (Souterhn Peru Copper Corp., Cuajone, Peru), "Grinding Controls Tested at Cuajone"; World Min. Equip. Vol. 9, No. 5, May 1985, pp. 52-65; ISSN 0746-729X; WMEGD

A533; 1 - Copper Ore Treatment - Crushing and Grinding; Grinding Mills - Ball Milling; Particle Size Monitors; Flotation; Grinding Balls

Treat: X (Experimental)

Southern Peru Copper Corporation's Cuajone Mine consists of a disseminated porphyry-type copper deposit mined by open-pit methods and a concentrator. One phase of the expansion program studied particle size monitor (PSM) from one ball mill. A mill being controlled by a PSM will produce at least 5% more tonnage than a mill operating without on-stream size control. With size control, flotation feed size varies between 7, 5 and 8. 5% + 65 mesh. Milling rate increases are sensitive to the physical condition of the cyclone feed pump, classifiers, shell and head liners, and variances in grinding ball load.

2840 Gupta, V.K., "Identification of Rod Mill Grinding Operation for Control Under Variable Ore Hardness Conditions"; 15th International Mineral Processing Congress (15th Congres International de Mineralurgie), Vol. III, Cannes, France, 2-9 June 1985, Edition Gedim, 19, rue du Grand-Moulin, 42029, St.-Etienne Cedex, France, 1985, pp. 41-48

41; Copper Ores, Beneficiation; Rod Mills (Grinding); Hardness; Particle Size Distribution; Mathematical Models; Process Control See also: 8510-72-0534

The suitability of a recently developed rod mill model for an on-line identification of the mill-ore grinding system for control purposes has been demonstrated using actual plant data. The plant operation was characterized by very significant variations in the (Cu) ore hardness. Also, the size distribution of the feed to the mill varied considerably due to segregation of particles in the feeder bin. Even under such unstable conditions, identification of the grinding system could be carried out successfully and efficiently using the new mill mathematical model. 17 ref.